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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/820,068	03/28/2001	Wei Pan	SLA 0493	4042

7590

12/17/2002

David C. Ripma, Patent Counsel
Sharp Laboratories of America, Inc.
5750 NW Pacific Rim Boulevard
Camas, WA 98607

EXAMINER

LUHRS, MICHAEL K

ART UNIT

PAPER NUMBER

2824

DATE MAILED: 12/17/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/820,068

Applicant(s)

PAN ET AL.

Examiner

Michael K. Luhrs

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-12,21 and 22 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-12,21 and 22 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☒ Other: updated search history.

DETAILED ACTION

Response to Amendment

1. The examiner acknowledges applicant's cancellation of claim 13. There is no allowable matter.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 2 and 4-6, 8-11 and 21-22 are rejected under 35 U.S.C. 102(e) as being anticipated by Itoh et. al. (USPN 6,455,421 B1).

Regarding claim 1, Itoh, et. al. disclose integrated circuit structure at different stages of fabrication sequence (lines 17-18, column 4) that includes a tantalum nitride (TaN) barrier layer, (line 19, column 4). The barrier layer is subject to a pre-treatment as described in lines 24-42, column 5: chamber pressure of about 0.1 torr to about 100 torr (line 38, column 5), is an ambient vacuum; hydrogen gas (line 28, column 5), argon gas (line 27, column 5), and helium gas (line 28, column 5); a temperature 200°C to about 600°C is indicated in line 37, column 5 which is a range greater than 200 degrees Celsius; for a time period of less than about 300 seconds (line 42, column 5), is a time period that includes "at least thirty seconds". Itoh et. al. disclose the subsequent deposition of the copper in lines 7-8, column 6.

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Regarding claim 2, Itoh et. al. teach a range of 200°C to about 600°C in line 37, column 5, as previously mentioned, that encompasses the claimed range of 250-550 degrees Celsius.

Claim 3 was cancelled.

Regarding claim 4, Itoh et. al. teach a range chamber pressure of about 0.1 torr to about 100 torr (line 38, column 5), as previously mentioned, whereas this range overlaps the range of 0.1 mtorr to 200 torr of the applicant's claim 4. In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. (See in re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976), also, in re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990)).

Regarding claim 5, Itoh et. al. disclose a time period of less than about 300 seconds (line 42, column 5), as previously mentioned, is a time period that includes 30 to 100 seconds.

Regarding claim 6, Itoh et. al. disclose deposition of the copper by chemical vapor deposition (CVD) in line 10-11, column 6, as shown in Fig. 3C for conductive material 206 formed in the trench, includes the sides and bottom. Itoh et. al. disclose that the width of the trench feature being less than about 0.2um (line 27, column 1) is the very reason Itoh. et. al. provide a new deposition of the TaN for better coverage in reduced circuit sizes. Therefore, given that Itoh et. al. can provide a TaN thickness of about 50 to about 100 Å (see line 23 column 5) the examiner would equate the remaining width of 0.2um minus 2 times the TaN thickness that results (approximately 0.18um) as being sufficiently proximate to the 0.13um value of claim 6, whereas Itoh et. al. point out that additional layers of TaN may be deposited, see lines 1-2, column 6, that would further reduce the width of the opening to which the copper is to be deposited into.

Regarding claim 8, Itoh et.al. teach of TaN.

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Regarding claim 9, the limitations of claim 9 have been addressed previously and would refer to the above claim 1, 5 and 6 rejections cited above.

Regarding claim 10, Itoh et. al. does disclose a simultaneously applied atmosphere (i.e. discussed above) with the vacuum (in lines 37-38, column 5), whereas the specific vacuum range has been addressed previously above for claim 4.

Regarding claim 11, the trench width has been addressed previously, refer to claim 7 above.

Regarding claim 21, the limitational difference between claim 21 and claim 1 is regarding the non-reactive atmosphere, whereas Itoh et. al. teach nitrogen -- nitrogen is considered as non-reactive, is included in line 28, column 5. The remaining limitations are the same as for claim 1 cited above.

Regarding claim 22, Itoh et. al. claim, in claim 11, a gas mixture of one or more of hydrogen argon, helium, and nitrogen, whereas the ambient vacuum has been previously pointed out above for claim 1 citation.

Claim Rejections - 35 USC § 103

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claim 7 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Itoh et. al. as applied to claim 1 and 9 respectively, above, and further in view of Paranjpe et. al. (USPN 6,461,675). Itoh et. al. do not disclose the survivability of the copper to withstand a tape test. Paranjpe discusses hfac precursor (in column 5, lines 54+) and also of anneal for adhering the copper to pass the tape test (see Table 1). Since Paranjpe et. al. and Itoh et. al. are all from the same field of endeavor, the purpose disclosed by Paranjpe et. al. would have been recognized in

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the pertinent art of Itoh et. al.. It would have been obvious at the time the invention was made to a person having ordinary skill in the art to modify the process of CVD taught by Itoh et. al. with MOCVD with hfac and also anneal as taught by Paranjpe et. al. for the purpose of passing the tape test.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Chern et. al., was cited in pertinent art in the previous office action, is now included on the examiner's 892, was absent previously. Langford et. al. (USPN 5,622,608) significant for Magnesium or Tantalum with the copper.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael K. Luhrs whose telephone number is 703-305-2864. The examiner can normally be reached on M-F; 8:00 a.m. - 5:00 p.m..

8. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard T. Elms can be reached on 703-308-2816. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

9. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Michael K. Luhrs
December 13, 2002



RICHARD ELMS
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800